

1. **[6 Points – 2 points for each box]** Consider the following hypothesis test:

$H_0: \mu \geq 10$	$H_1: \mu < 10$
$n = 81$	$\bar{X} = 9$
$\sigma = 10$	$\alpha = 0.02$

- a. What are the value(s) of the critical statistic?

[3]

- b. What is the value of the observed statistic?

[3]

- c. "Reject" / "Do not reject" null hypotheses?

2. **[6 Points – 2 points for each box]** Consider the following hypothesis test:

$H_0: \mu = 0$	$H_1: \mu \neq 0$
$n = 64$	$\bar{X} = 2$
$\sigma = 5$	$\alpha = 0.01$

- a. What are the value(s) of the critical statistic?

[3]

- b. What is the value of the observed statistic?

[3]

- c. "Reject" / "Do not reject" null hypotheses?

3. [13 Points – 1 point each]

Consider the following hypothesis test:

$H_0: \mu \geq -1$	$H_1: \mu \leq -1$
$n = 81$	$\bar{X} = -11$
$\sigma = 50$	$\alpha = 0.05$

Comparing Z_{Observed} to Z_{Critical}

- a. What are the values of Z_{Critical} ? Express each answer to 3 decimal places. Answer must be 3 decimal places to receive credit.

 [3]

- b. What is the value of Z_{Observed} ? Express the answer to 3 decimal places. Answer must be 3 decimal places to receive credit.

 [3]

- c. "Reject" / "Do not reject" null hypotheses?

- d. Reason for "Reject" / "Do not reject".

Comparing p-value to α

- e. What is the p-value? Express the answer to 3 decimal places. Answer must be 3 decimal places to receive credit.

 [4]

- f. "Reject" / "Do not reject" null hypotheses?

- g. Reason for "Reject" / "Do not reject".

Confidence Interval

- h. What is the confidence interval? Express each answer to 3 decimal places. Answer must be 3 decimal places to receive credit.

 [3]

- i. "Reject" / "Do not reject" null hypotheses?

- j. Reason for "Reject" / "Do not reject".

Comparing $\bar{X}_{\text{Observed}}$ to $\bar{X}_{\text{Critical}}$

- k. What are the values of $\bar{X}_{\text{Critical}}$? Express each answer to 3 decimal places. Answer must be 3 decimal places to receive credit.

 [3]

- l. "Reject" / "Do not reject" null hypotheses?

- m. Reason for "Reject" / "Do not reject".

4. [8 points total – 2 points for each box]

In the following sample size calculation problem, determine the missing values for each question. Answers must have the number of decimal places as indicated in the answer box to receive credit. Assume a two-tail test for all problems. (Error = $\bar{x} - \mu$)

a

Error	σ	Confidence	Sample Size
± 0.050	15.00	98.00%	[0]

b

Error	σ	Confidence	Sample Size
± 10.000	120.00	[2]	600

c

Error	σ	Confidence	Sample Size
± 1.000	[2]	98.00%	74

d

Error	σ	Confidence	Sample Size
[3]	4.00	95.00%	62

5. **[10 Points – 2 points for each box]**

Given the information below:

$H_0: \mu_0 \geq 20$	$H_1: \mu_0 < 20$	$\sigma = 15$
$\alpha = 0.01$	$n = 81$	$\mu_1 = 12$

- a. Determine the Z_{critical} value for the hypothesized distribution. Express your answer to 3 decimal places. Answer must have 3 decimal places to receive credit.

 [3]

- b. Calculate $\bar{X}_{\text{critical}}$? Express your answer to 3 decimal places. Answer must have 3 decimal places to receive credit.

 [3]

- c. Calculate Z_1 for the actual distribution. Express your answer to 3 decimal places. Answer must have 3 decimal places to receive credit.

 [3]

- d. Using the answer in part (c) rounded to 2 decimal places, calculate Type II (β) error. Express your answer to 4 decimal places. Answer must have 4 decimal places to receive credit.

 [4]

- e. Calculate power of the test? Express your answer to 4 decimal places. Answer must have 4 decimal places to receive credit.

 [4]

Use the following to answer questions 6-7

A researcher plans to conduct a test of hypotheses at the 1% significance level. She designs her study to have a power of 0.90 at a particular alternative value of the parameter of interest.

6. The probability that the researcher will commit a type I error is
 - A) 0.01.
 - B) 0.10.
 - C) 0.90.
 - D) equal to the P -value and cannot be determined until the data have been collected.
7. The probability that the researcher will commit a type II error for the particular alternative value of the parameter at which she computed the power is
 - A) 0.01.
 - B) 0.10.
 - C) 0.90.
 - D) equal to $1 - (P\text{-value})$ and cannot be determined until the data have been collected.

Use the following to answer questions 8-9:

Bags of a certain brand of tortilla chips claim to have a net weight of 14 ounces. Net weights actually vary slightly from bag to bag and are normally distributed with mean μ . A representative of a consumer advocate group wishes to see if there is any evidence that the mean net weight is less than advertised and so intends to test the following hypotheses:

$$H_0: \mu_0 \geq 14, H_a: \mu_0 < 14.$$

To do this, he selects 16 bags of this brand at random and determines the net weight of each. He finds the sample mean to be $\bar{x} = 13.88$ and the sample standard deviation to be $s = 0.24$.

8. Based on these data, we would conclude
 - A) we would reject H_0 at significance level 0.10 but not at 0.05.
 - B) we would reject H_0 at significance level 0.05 but not at 0.025.
 - C) we would reject H_0 at significance level 0.025 but not at 0.01.
 - D) we would reject H_0 at significance level 0.01.
9. Suppose we were not sure if the distribution of net weights was normal. In which of the following circumstances would we not be safe using a t -procedure in this problem?
 - A) The mean and median of the data are nearly equal.
 - B) A histogram of the data shows moderate skewness.
 - C) A stemplot of the data has a large outlier.
 - D) The sample standard deviation is large.

Use the following to answer questions 10-13:

A food company is developing a new breakfast drink and their market analysts are currently working on preliminary taste testing studies. To help with their marketing strategy, they were first interested in whether preference for the new product was related to a person's gender. There were 100 male and 100 female volunteers available for the taste test. Both the males and females tasted the product and rated the flavor on a scale of 1 to 10, 1 being "very unpleasant" and 10 being "very pleasant." The mean rating for males was $\bar{x}_1 = 6.4$, with a standard deviation $s_1 = 1.5$. The mean rating for females was $\bar{x}_2 = 7.0$, with a standard deviation $s_2 = 2.0$. Let μ_1 and μ_2 represent the mean ratings we would observe for the populations of males and females, respectively, and assume our samples can be regarded as samples from these populations.

Suppose the researcher had wished to test the hypotheses: $H_0: \mu_1 = \mu_2$, $H_a: \mu_1 \neq \mu_2$.

Use the conservative value for the degrees of freedom

10. A 90% confidence interval for $\mu_1 - \mu_2$ is
 - A) -0.6 ± 0.25 .
 - B) -0.6 ± 0.32 .
 - C) -0.6 ± 0.42 .
 - D) -0.6 ± 0.5 .
11. The numerical value of the two-sample t statistic is
 - A) -2.00.
 - B) -2.40.
 - C) -3.25.
 - D) -9.60.
12. The P -value for the test is:
 - A) larger than 0.10.
 - B) between 0.10 and 0.05.
 - C) between 0.05 and 0.01.
 - D) below 0.01.
13. Which of the following would lead us to believe that the t -procedures were not safe to use here?
 - A) The sample medians and means for the two groups were slightly different.
 - B) The distributions of the data were moderately skewed.
 - C) The data are integers between 1 and 10 and so cannot be normal.
 - D) Only the most severe departures from normality would lead us to believe the t -procedures were not safe to use.

14. A small company consists of 25 employees. As a service to the employees, the company arranges for each to have a complete physical for free. Among other things, the weight of each employee is measured and the mean weight is found to be 165 pounds. The population standard deviation is 20 pounds. It is believed that a mean weight of 160 pounds would be normal for this group. To see if there is evidence that the mean weight of the population of all employees of the company differs significantly from 160, the hypotheses tested is:

$$H_0: \mu \leq 160, H_a: \mu > 160$$

You obtain a P -value of less than 0.1056. Which of the following is true?

- A) At the 5% significance level, you have proved that H_0 is true.
 - B) You have failed to obtain any evidence for H_a .
 - C) At the 5% significance level, you have failed to prove that H_0 is true and a larger sample size is needed to do so.
 - D) At the 5% significance level, you do not have significant evidence that H_0 is false.
15. Recent revenue shortfalls in a midwestern state led to a reduction in the state budget for higher education. To offset the reduction, the largest state university proposed a 25% tuition increase. It was determined that such an increase was needed to simply compensate for the lost support from the state. Random samples of 50 freshmen, 50 sophomores, 50 juniors, and 50 seniors from the university were asked whether or not they were strongly opposed to the increase, given that it was the minimum increase necessary to maintain the university's budget at current levels. The results are given in the following table.

<u>Strongly Opposed</u>	<u>Year</u>			
	<u>Freshmen</u>	<u>Sophomore</u>	<u>Junior</u>	<u>Senior</u>
Yes	39	36	29	18
No	11	14	21	32

Which hypotheses are being tested by the chi-square test?

- A) The null hypothesis is that year in school and whether or not you are strongly opposed are independent, and the alternative is that they are dependent.
- B) The null hypothesis is that the mean number of who are strongly opposed is the same for each of the four years, and the alternative is that these means are different.
- C) The null hypothesis is that the distributions of the number who are strongly opposed versus not strongly opposed are the same for the four years. The alternative says that these distributions are different.
- D) The null hypothesis is that the distributions of the total number of students sampled in each of the four years are the same. The alternative is that these distributions are different.

Use the following to answer questions 16-19:

Even though Puerto Rico is a territory of the United States, there are many cultural differences between the states on the continent and the island of Puerto Rico. These differences include the way consumers handle problems with purchases. Two researchers surveyed owners of televisions in the northeast U.S. and in Puerto Rico. They asked those who had experienced problems with their televisions whether they complained.

The results are given in the table below.

Complained	States	Puerto Rico	Total
No	94	33	127
Yes	330	64	394
Total	424	97	521

The Expected Values are given below.

Complained	States	Puerto Rico	Total
No	103.36	23.64	127
Yes	320.64	73.36	394
Total	424	97	521

$$\chi^2 = 0.847 + 3.701 + 0.273 + 1.193 = 6.014$$

16. This is an $r \times c$ table. The number r has value
- A) 1.
 - B) 2.
 - C) 3.
 - D) 4.
17. The appropriate degrees of freedom for the chi-square statistic is
- A) 1.
 - B) 2.
 - C) 3.
 - D) 4.
18. The cell that contributes most to the chi-square statistic is
- A) Americans in the states that did not complain.
 - B) Americans in the states that complained.
 - C) Puerto Ricans that did not complain.
 - D) Puerto Ricans that did complain.
19. The P -value for testing the null hypothesis that the probability of complaining is the same for the States and Puerto Rico, against the alternative that the probability is different for the States and Puerto Rico
- A) is between 0.025 and 0.05.
 - B) is between 0.010 and 0.025.
 - C) is less than 0.010.
 - D) cannot be determined because these are not the hypotheses being tested by the chi-square test.